The ALAR Project at Purdue University

http://www.chem.purdue.edu/shepson/ALAR.htm

PURDUE
BOILERMAKERS

The ALAR Project Team

Left to right: Prof. Dominick Andrisani (Aer. Eng.), Kimberly Hill (EAS grad. stud.), Doug Martins (EAS grad. stud.), Rose Ravelo (CHEM grad. stud.), Greg Hawkins (Chem., machinist), Prof. Paul Shepson (Chem./EAS - PI), Prof. Tom Carney (Head - AT), Dr. Bob Santini (JAFCI Director, Chem.), Karl Garman (grad. student, Aer. Eng.), Mark Carlsen (Instr. Eng., JAFCI), Brian Stirm (AT, Dir. of Maintenance), Randy Replogle (Chem., machinist)

Teamwork at Purdue!!

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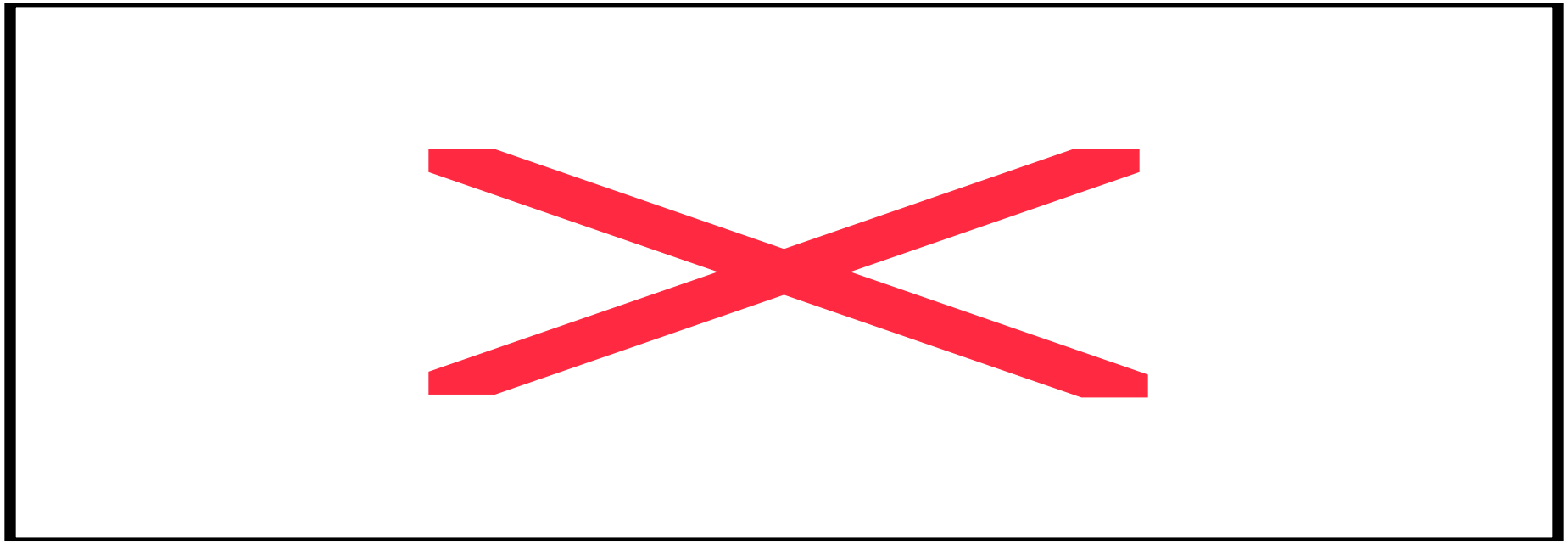
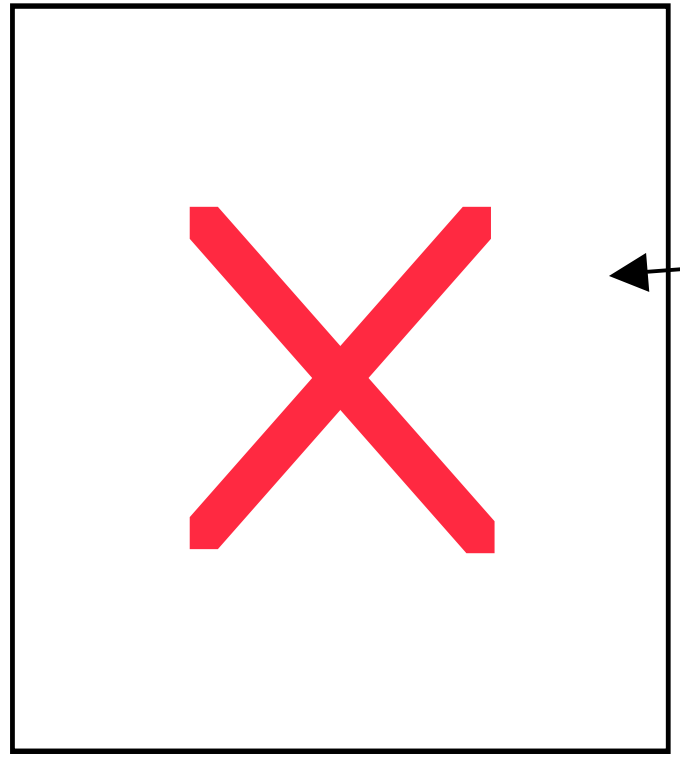
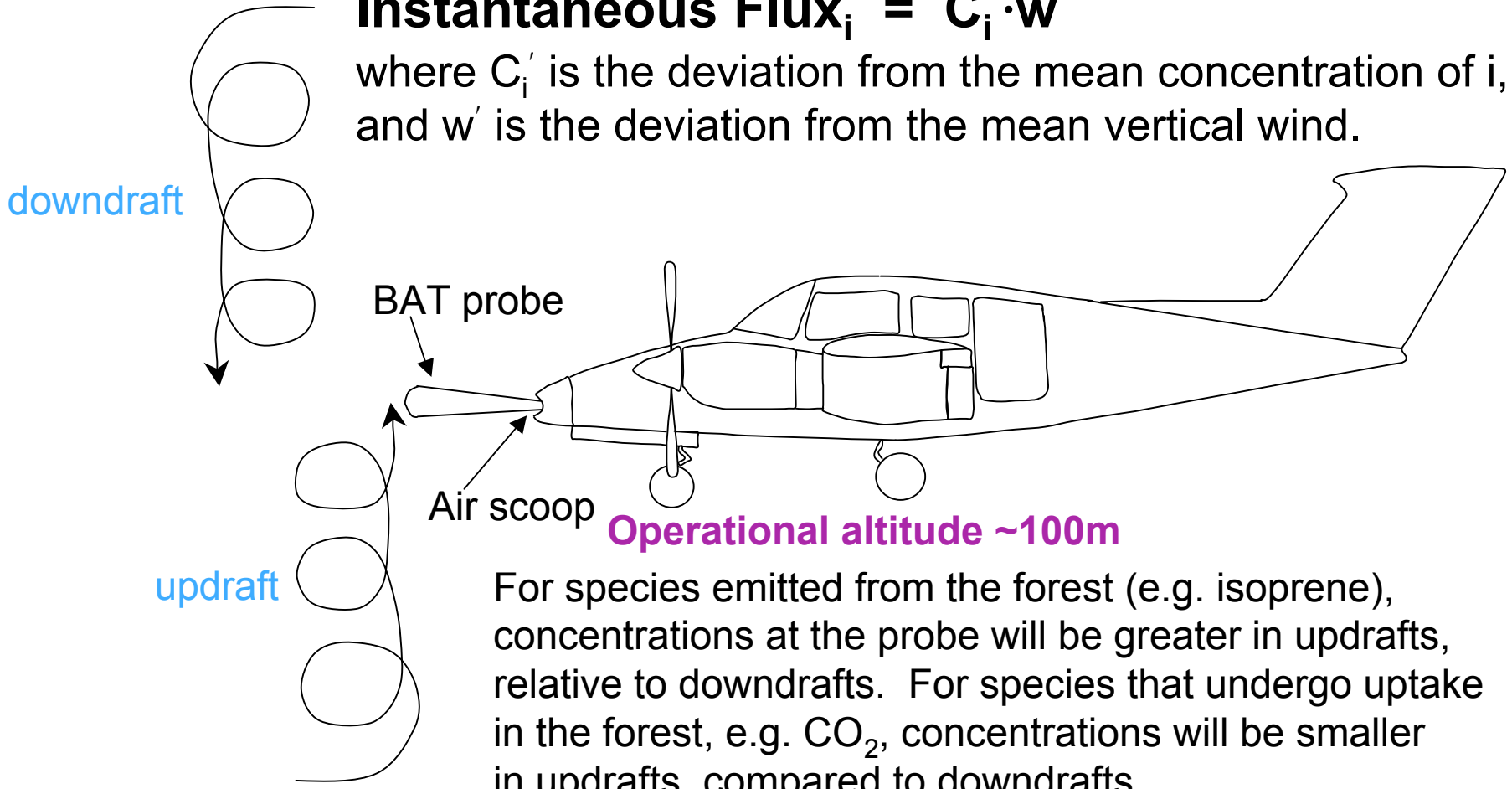




Front view of BAT probe

Instantaneous Flux$_i$ = $C_i' \cdot w'$

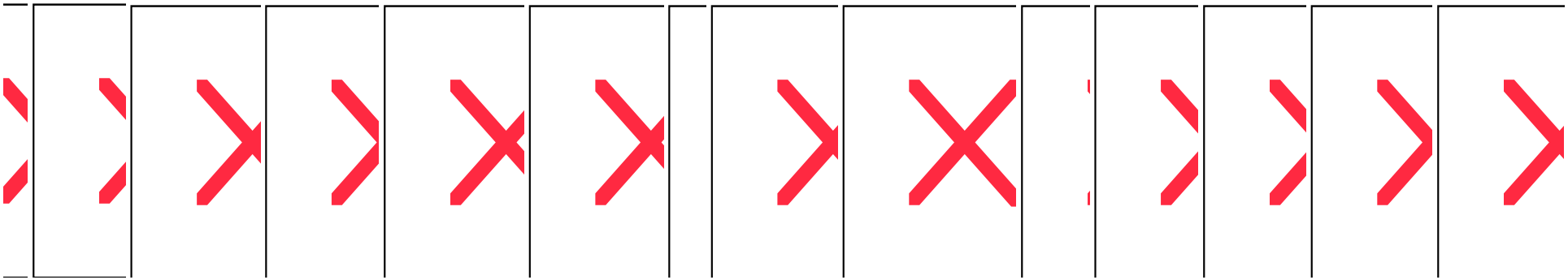
where C_i' is the deviation from the mean concentration of i, and w' is the deviation from the mean vertical wind.

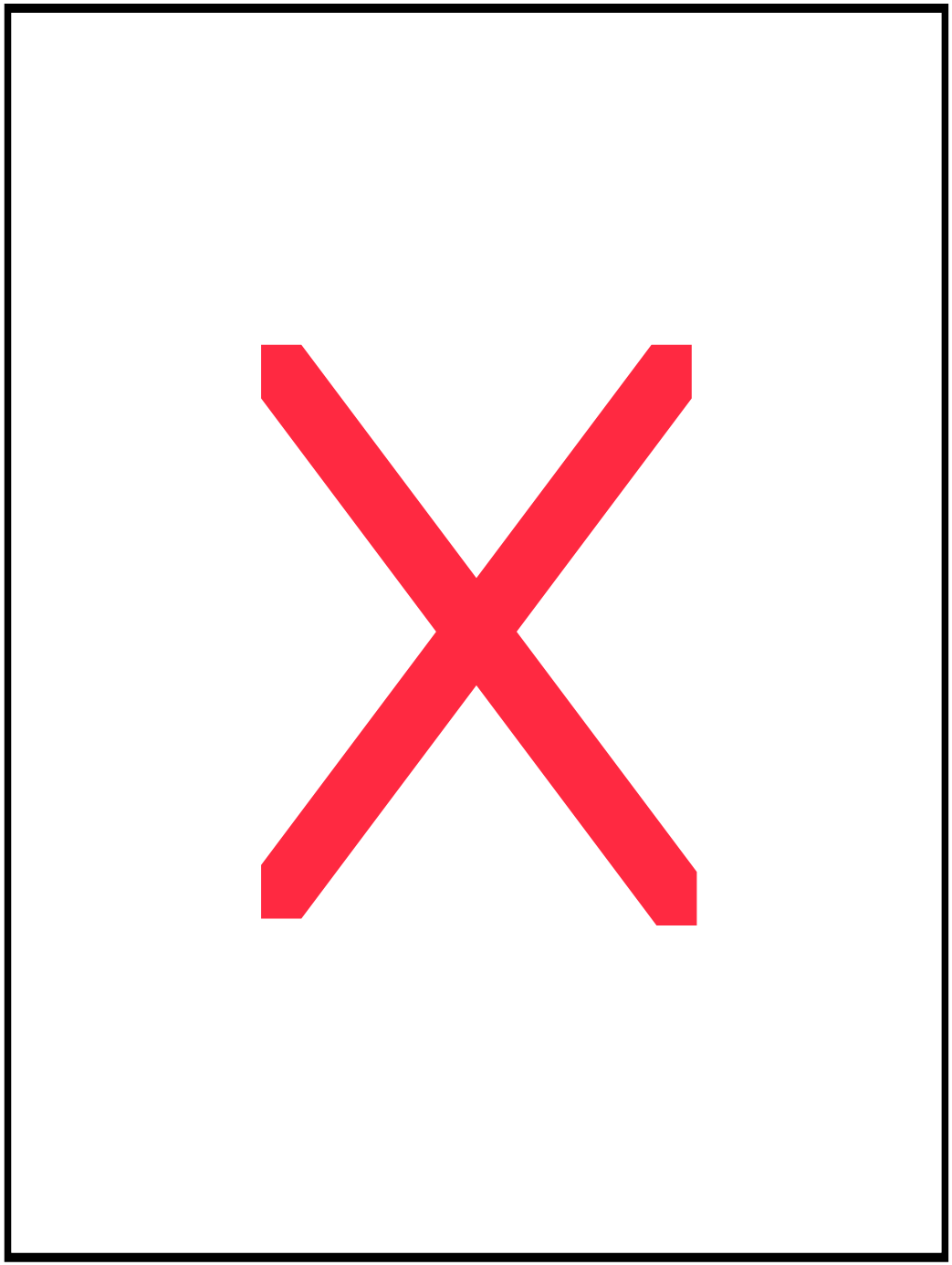


Operational altitude ~100m

For species emitted from the forest (e.g. isoprene), concentrations at the probe will be greater in updrafts, relative to downdrafts. For species that undergo uptake in the forest, e.g. CO_2, concentrations will be smaller in updrafts, compared to downdrafts.

To get fluxes in real time, we need to calculate w' at 10Hz!





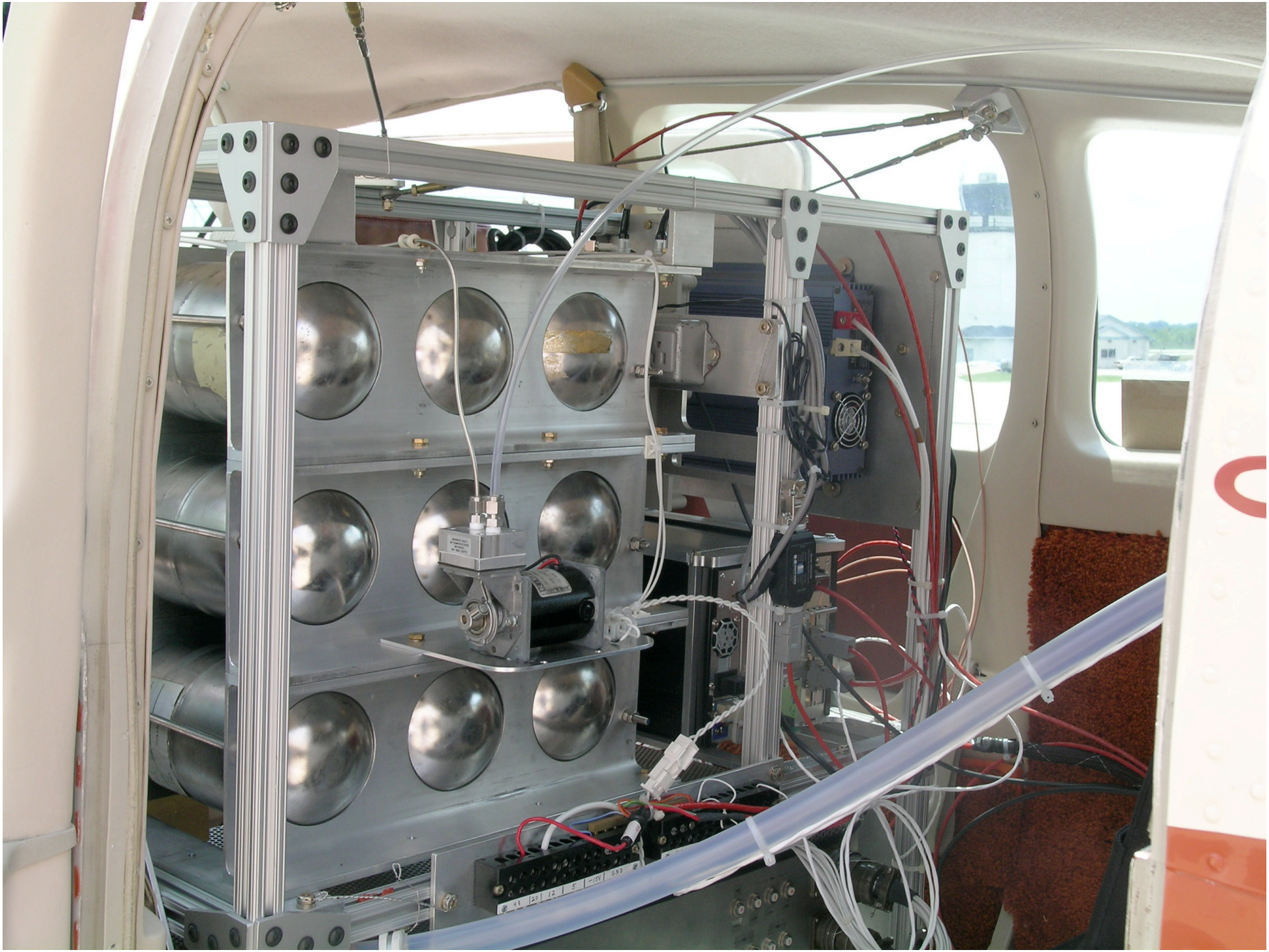
CO_2/H_2O measurements via
P- and T-controlled LICOR7000,
With on-board real-time
Calibrations.

ALAR Project Objectives

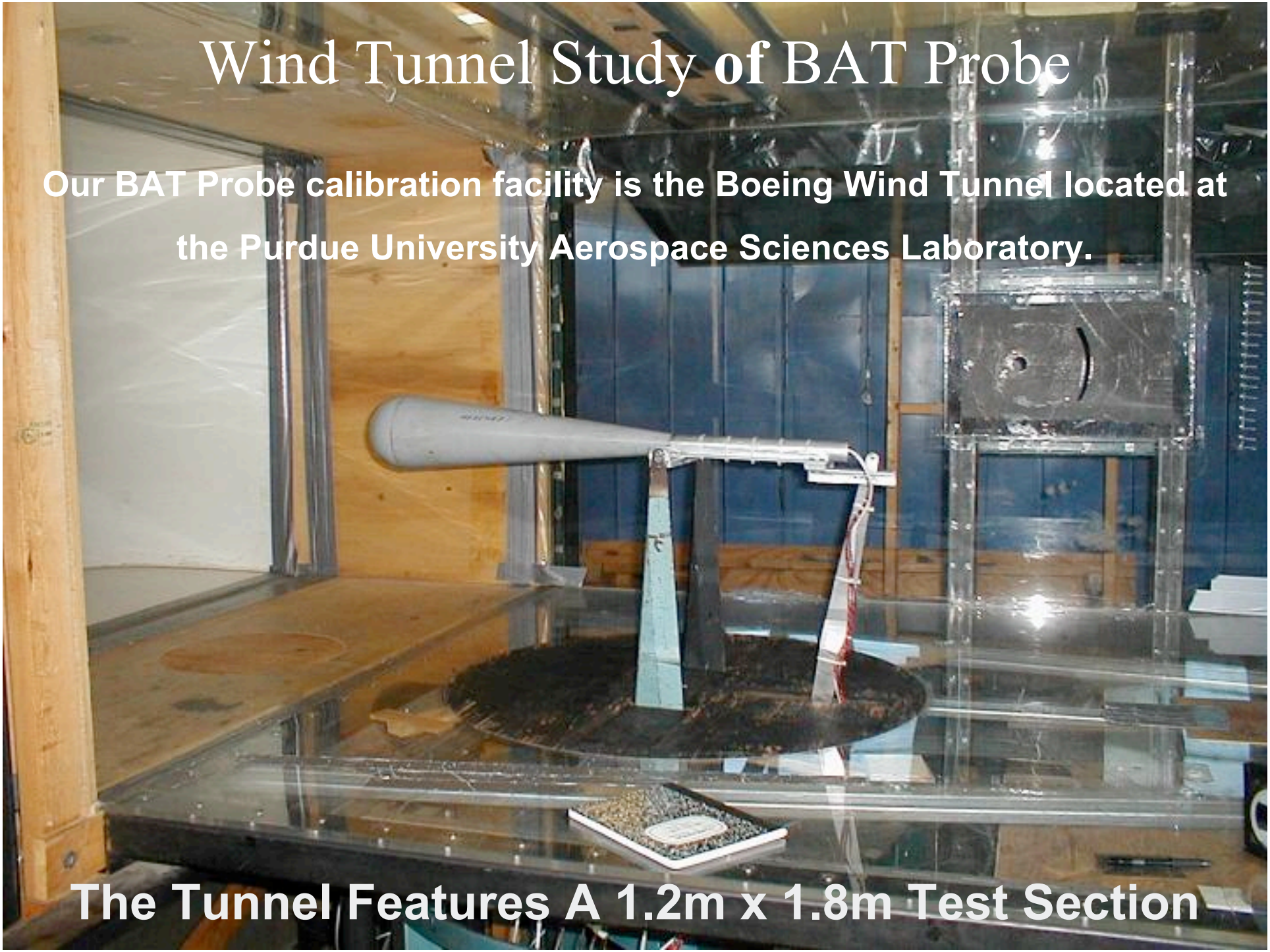
- **Study of coupling between the C and N-cycles in forest environments**
- **Measurements and modeling of NEE across heterogeneous landscapes**

**The intent is bottom up,
But we can also obtain top down
Measurements.**


The Best Aircraft Turbulence Probe



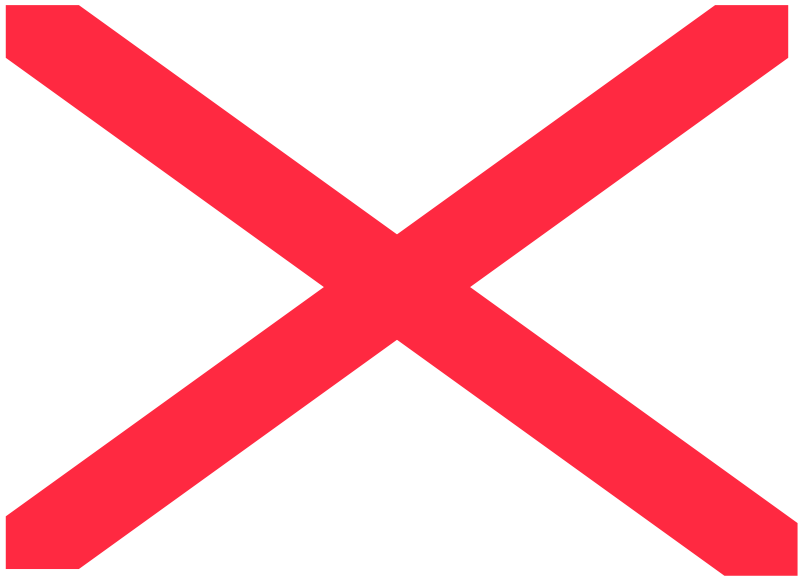
Wind Tunnel Study **of** BAT Probe



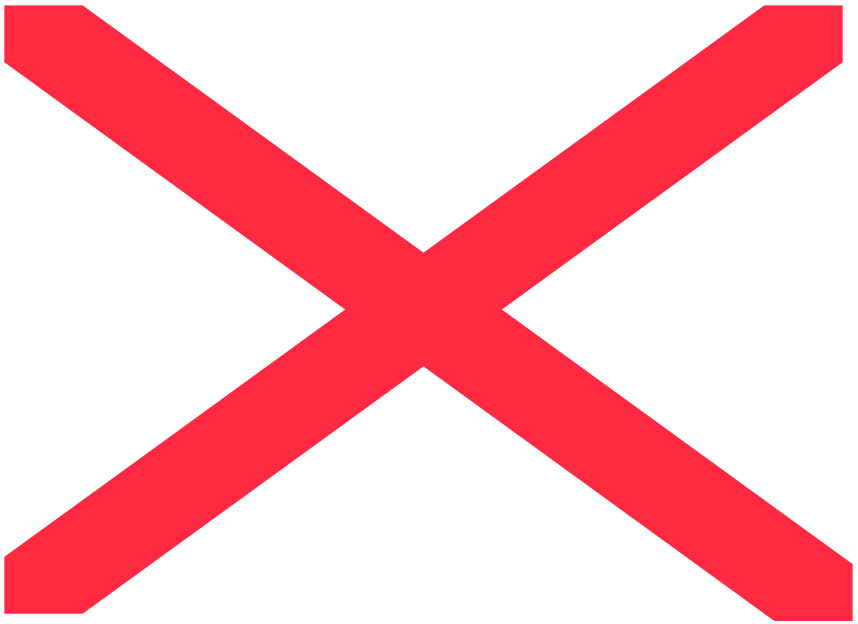
Our BAT Probe calibration facility is the Boeing Wind Tunnel located at the Purdue University Aerospace Sciences Laboratory.

The Tunnel Features A 1.2m x 1.8m Test Section

Attack angle calibration



Sideslip angle calibration

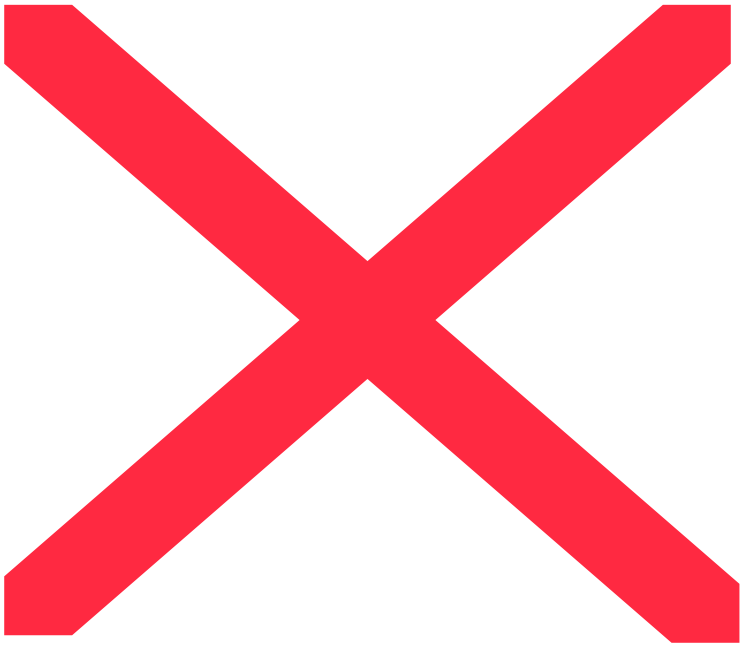


In-Flight calibration of attack angle

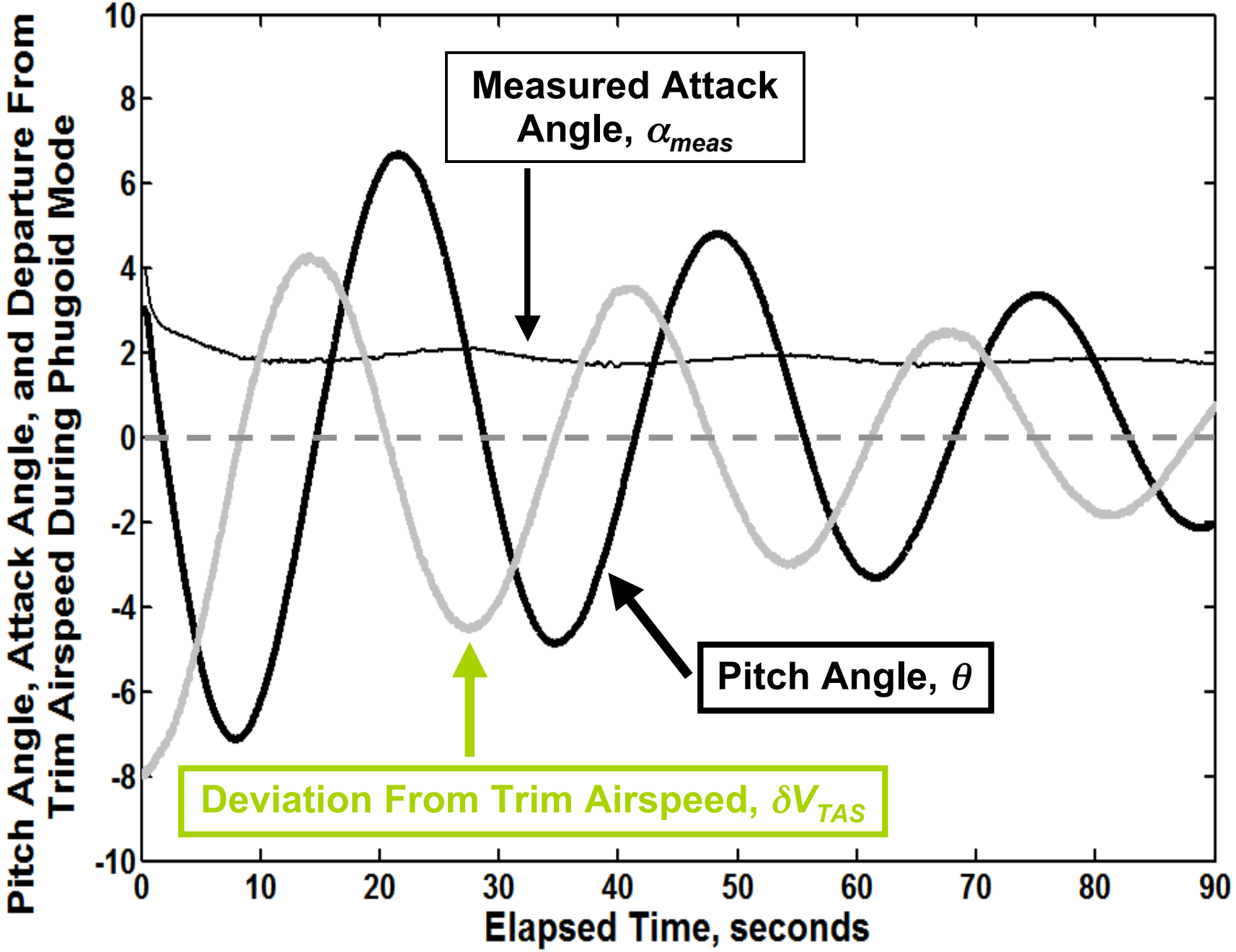
Wind-tunnel calibrated

Non-Wind-tunnel calibrated

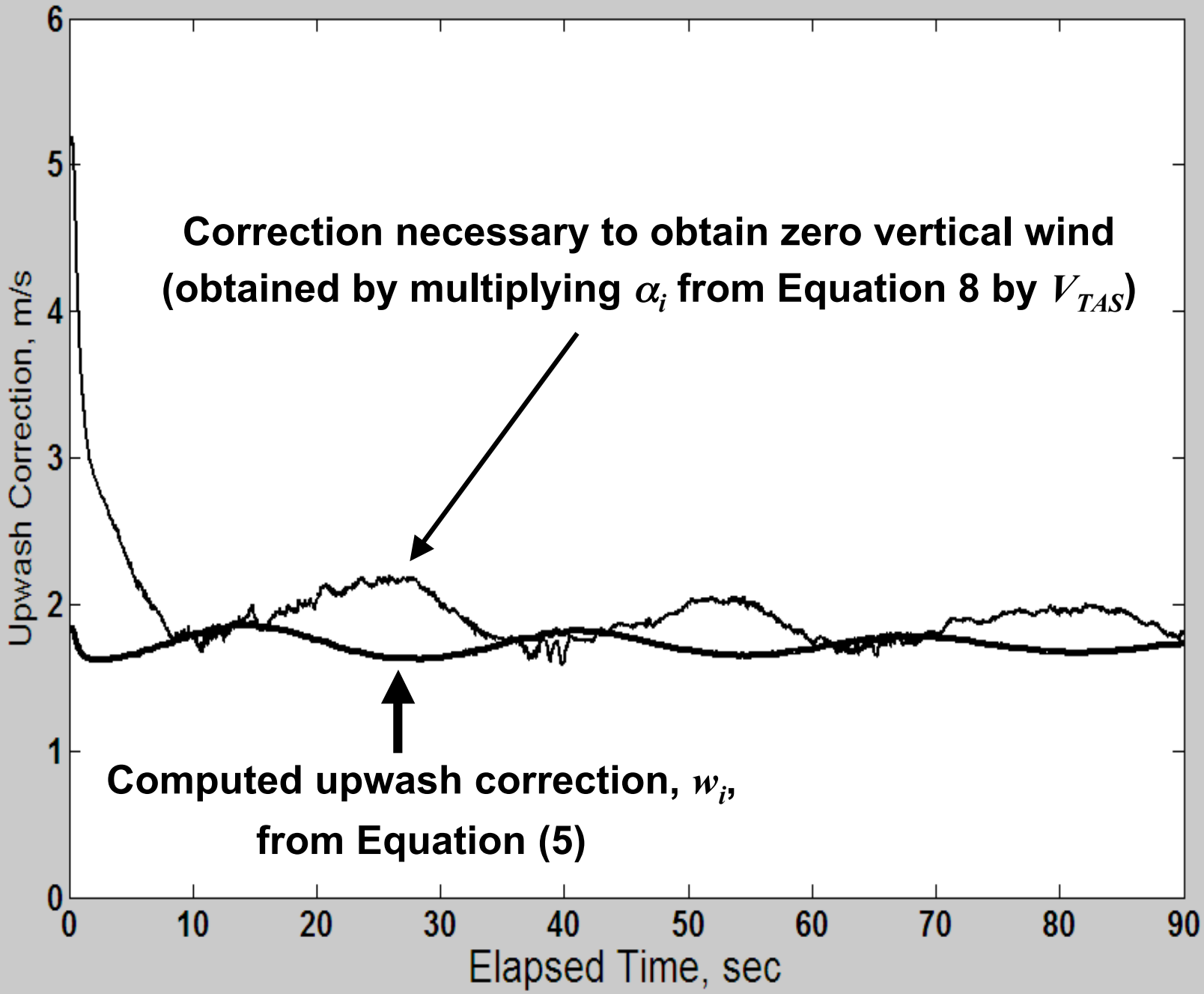
3cm/s precision in w



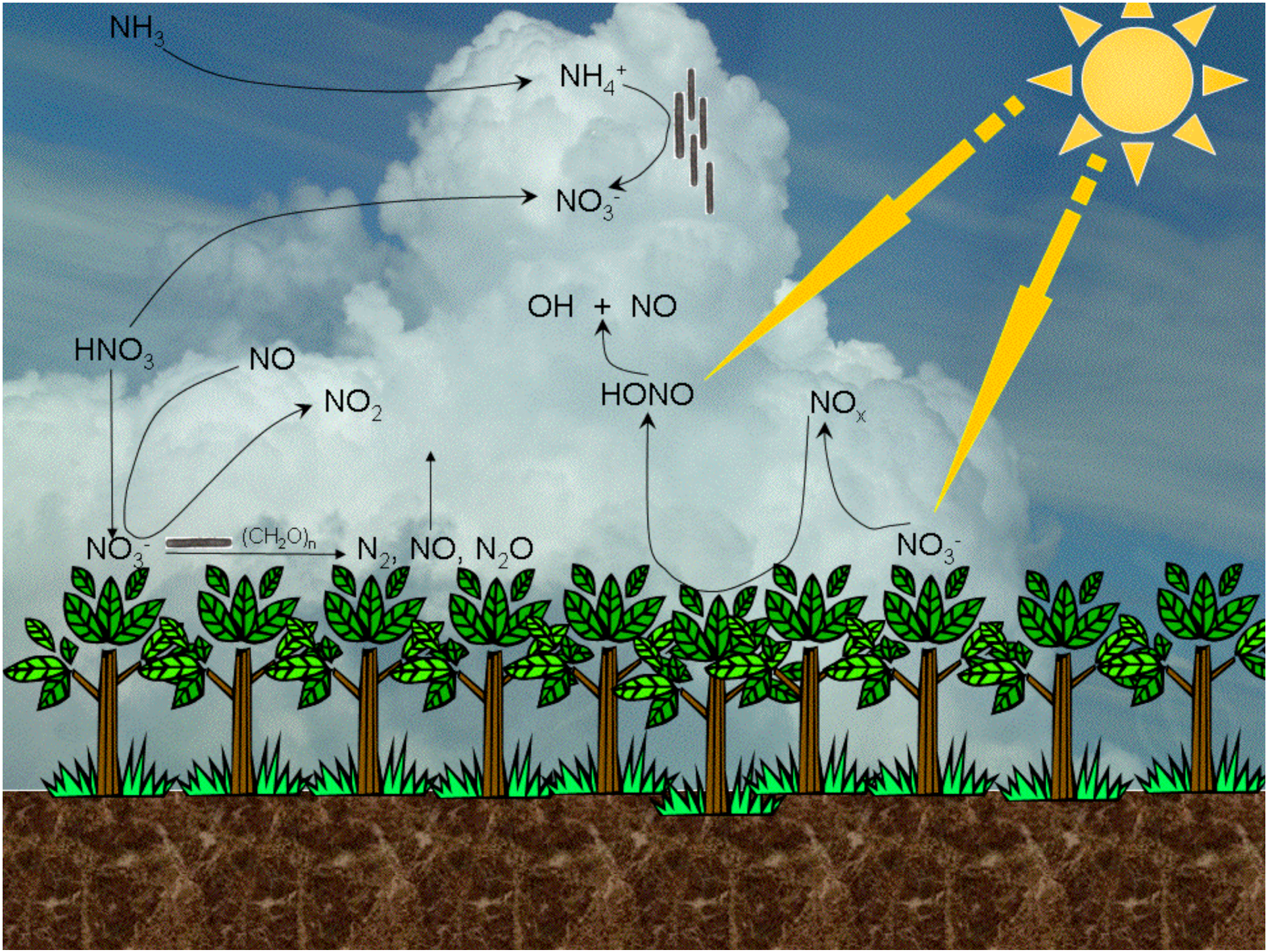
Phugoid mode Experiment Data



Comparison of Crawford upwash correction (Equation 5) with correction necessary to compute zero vertical wind



Cloud water collector on the Purdue
Airborne Laboratory for Atmospheric Research (ALAR)


NH3
NH4+
NO3-
HNO3
NO
NO2
OH + NO
HONO
NOx
NO3-
(CH2O)n
N2, NO, N2O
NO3-

Conclusions

- Flux measurements from an aircraft is difficult.
- We can do it!
- ALAR is a low-cost platform!